

The Effect of General Education Inclusion on College Enrollment Rates
Among Youth with Autism Spectrum Disorder

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Abstract

Using data from waves 1 through 5 of the National Longitudinal Transition Study-2, this study used propensity score techniques to assess the relationships between general education inclusion and college enrollment rates among youth with Autism Spectrum Disorder (ASD). Data show that 2- or 4-year college enrollment rates were significantly higher among youth with ASD who were included in high school general education core academic classes (math, science, or social studies) than among their peers with ASD who were not included in these classes. Educational implications are discussed.

Keywords: general education inclusion, autism, English, math, science, social studies, postsecondary education enrollment, propensity score weighting

Introduction

A college education opens many life opportunities for those who attend and graduate. Yet, many young adults with autism spectrum disorder (ASD) do not attend or complete college and struggle as they transition to adulthood (Shattuck et al., 2012). The “emerging adulthood” period, generally considered to be between ages 18 and 25 (Arnett & Tanner, 2006), is a critical time of transition for all youth, but the post-high school outcomes of youth with ASD are particularly “sobering” (Hendricks & Wehman, 2009, p. 82). The college enrollment rate among students in the general population is 67.4% (Newman, Wagner, Huang, et al., 2011; Newman, Wagner, Knokey, et al., 2011), but nationally representative data indicate that only 34.7% of young adults with autism enrolled in 2- or 4-year colleges at any time during the first 6 years after high school (Shattuck et al., 2012). Other studies also find consistently low college enrollment rates among youth with ASD (Eaves & Ho, 2008; Howlin, Mawhood, & Rutter, 2000).

Not attending and completing college can have significant economic costs. In 2012, high school graduates earned only 58.8% of what college graduates earned and had an unemployment rate almost double that of college graduates (U.S. Bureau of Labor Statistics, 2013). College education also can confer a variety of less tangible benefits for youth with disabilities, including the opportunity to build social, communication, self-advocacy, and self-esteem skills that improve the quality of life (Hart, Grigal, Sax, Martinez, & Will, 2006; Hart, Grigal, & Weir, 2010; The Roeher Institute, 1996; Zafft, Hart, & Zimbrich, 2004).

Although college enrollment rates for youth with ASD are low relative to the general population and to students in most other disability categories, youth express a great deal of interest in postsecondary education (PSE) while they are in high school. In a nationally representative survey, 84.4% of youth with ASD reported that they definitely (47.2%) or

probably (37.2%) would get some PSE, although their parents tended to hold lower expectations for their children's PSE achievements than youth held for themselves (Wagner, Newman, Cameto, Levine, & Marder, 2007). The high school years are an opportune time to encourage and prepare youth for PSE participation, but doing so may require educators to pay greater attention to the instructional programs, services, and supports in high school that are likely to support their PSE aspirations. Some scholars have made broad recommendations for improving post-high school outcomes, including strengthening transition planning, involving adult service providers as collaborators in the transition planning process, and identifying instructional strategies such as differentiated instruction or assistive technology that might effectively increase the academic performance of students with ASD (Hendricks & Wehman, 2009; Iovnannone, Dunlap, Huber, & Kincaid, 2003; The Ontario Ministry of Education, 2007; Wehman, Smith, & Schall, 2009). However, little is known about the specific types of interventions and services high schools can provide to improve their odds of PSE enrollment. Given the increasing prevalence of children and youth with ASD (Centers for Disease Control and Prevention, 2013), there is a growing need for evidence-based instructional strategies and interventions for high school students with ASD.

Including Students with Disabilities in General Education Settings

The evolution of federal special education legislation since the 1975 passage of the Education for All Handicapped Children Act (EHA, PL 94-142) has seen a steady strengthening of the intent that youth with disabilities participate in inclusive educational environments. The "least restrictive environment" (LRE) provision of what is now the Individuals with Disabilities Education Act (IDEA) requires that students be educated in general education classrooms provided that they are able to function effectively with supports, such as curriculum

modifications and the use of paraprofessionals. Nonetheless, there are debates regarding the interpretation of the LRE provision given the complex academic, social, and communication needs of many students with ASD (Simpson, de Boer-Ott, & Smith-Myles, 2003). Nationally, high school students with ASD earn about half their high school credits (53.6%) in general education classes¹ and only 46.7% of their credits in core academic classes such as English, math, science, and social studies (Newman, Wagner, Huang, et al., 2011). Though research is limited, it appears that greater cognitive skills and a less pervasive disorder are associated with greater inclusion in general education classrooms among youth with ASD (Eaves & Ho, 1997; S. W. White, Scahill, Klin, Koenig, & Volkmar, 2007).

Linking General Education Inclusion and PSE Outcomes among Youth with ASD

Most studies exploring the impact of general education inclusion focus on young children with ASD and find that inclusion may promote positive outcomes such as improved adaptive behavior, social skills, and communication skills (Harrower & Dunlap, 2001; Stahmer, Akshoomoff, & Cunningham, 2011; Stahmer & Ingersoll, 2004). Relatively few studies investigate inclusion practices in high school or link high school inclusion with post-high school outcomes for youth with ASD or other significant disabilities (Harrower & Dunlap, 2001; Ryndak, Hughes, Alper, & McDonnell, 2012), but studies of youth with other disabilities have found that high school experiences play a significant role in a student's successful enrollment and participation in PSE. For these youth, attending a regular high school and participating in

¹ The content focus of general education classes can include academic, fine and performing arts, physical education, occupational vocational, work study/cooperative education, prevocational, life skills, learning supports, or other content area.

general education classes have been shown to increase the likelihood of attending PSE (Baer et al., 2003; Test et al., 2004; Test, Mazzotti, Mustian, & Fowler, 2009).

For high school students with ASD, researchers assert that inclusion in general education promotes the acquisition of social and communication skills from their peers and supports the development of academic skills necessary for PSE success (Leach & Duffy, 2009). A study of 15 adolescents' individualized education programs (IEP) found that students who spent more time in general education settings had IEP goals that included more higher-order thinking skills related to reading, writing, and math. In addition, students in general education classrooms met their IEP goals more often than those not in general education (Kurth & Mastergeorge, 2010). Furthermore, including students with ASD in advanced math classes in a general education setting is associated with higher odds of choosing a college major in science, technology, engineering, and math (STEM) fields (Wei, Yu, Shattuck, & Blackorby, 2015). This indicates that academic rigor might be an important aspect of general education for youth with ASD and identifies a need to explore how the types of classes a student enrolls in can help prepare them for PSE.

However, it is also important to note that the above studies are correlational in nature. The association between high school factors and postsecondary attendance can be confounded by cognitive and non-cognitive factors such as student motivation, self-determination, and perseverance. A study using a more rigorous quasi-experimental design compared three groups of students with ASD who differed in their level of participation in general education classes (i.e., no participation in general education, 1% to 74% of courses taken in general education classroom, and 75% or more of courses taken in general education classroom) and found that the degree of inclusion in general education had a negligible effect on high school dropout rates,

college enrollment rates, or functional cognitive scores (Foster & Pearson, 2012). In addition, numerous factors are associated with college attendance in young adults with ASD including greater functional independence, fewer limitations in functional areas [e.g., conversation, vision, and hearing (Cameto, 2005; Carter, Austin, & Trainor, 2012; NewmaASDn, 2005a)], better high school academic performance (Chiang, Cheung, Hickson, Xiang, & Tsai, 2012; Shattuck et al., 2012; Taylor & Seltzer, 2011), higher family income, non-Hispanic/non-African American racial or ethnic status, and a longer time out of high school (Chiang et al., 2012; Shattuck et al., 2012).

When linking course-taking patterns and college enrollment, studies of the general population emphasize the influence of taking a core academic curriculum, which is defined as 4 years of high school English and 3 years each of mathematics, science, and social studies (ACT, 2014). Students in the general population who took this core academic curriculum were more likely to be “college and career ready” than their peers who did not (ACT, 2005, 2006, 2014), demonstrating that academic rigor in high school is important for later academic success. However, few studies to date have investigated whether inclusion in a core academic curriculum can promote postsecondary participation for students with ASD in the U.S.

Study’s Purpose

Research on general education inclusion of youth with disabilities is dominated by small studies and convenience samples (e.g., Baer et al., 2003; Test et al., 2004; Test et al., 2009), and, with the exception of the Foster and Pearson study (2012), most are descriptive and correlational. Further, measures used in these studies often fail to differentiate between academic (i.e., English, math, science, social studies) and non-academic classes (e.g., life skills classes, occupational classes, physical education) and do not capture the difficulty of the academic classes taken. Finally, few studies have examined the general education inclusion of students with ASD. A

larger-scale rigorous study on the relationship between general education inclusion of students with ASD, particularly in the four core academic subjects, and postsecondary enrollment is needed. Findings will be useful for parents, advocates, and educators who hope to improve postsecondary outcomes for the growing ASD population.

This study draws on data from the National Longitudinal Transition Study-2 (NLTS2) to explore the effect of inclusion in general education academic classes on the 2- or 4-year college participation of students with ASD. This study addresses two research questions.

1. Is participation in any general education courses (including academic, fine and performing arts, physical education, occupational/vocational, work study/cooperative education, prevocational, life skills, learning supports, or other content area) predictive of college enrollment in students with ASD?
2. Is participation specifically in core general education academic courses (English, mathematics, science, and/or social studies) predictive of college enrollment for students with ASD?

Methods

Data Sources

Conducted by SRI International for the U.S. Department of Education, NLTS2 is the largest and most comprehensive data set available that generalizes nationally to the experiences of youth with disabilities as a whole and youth in each special education disability category as they transitioned from high school to early adulthood. NLTS2 data were collected from parents and/or

youth and schools in five waves², 2 years apart, from 2001 to 2009 with the intent to document their high school experiences and their outcomes during and after high school.

NLTS2 involved several data collection methods: (a) telephone interviews or surveys with parents or youth were administered at each wave; (b) school and teacher surveys were administered at waves 1 and 2; (c) direct assessments of students' abilities were administered once either at wave 1 or wave 2, when youth were 16-18 years old; (d) a school characteristics survey was administered at wave 1; and (e) transcript data were collected every year from 2002 to 2009.

The NLTS2 two-stage sampling plan first randomly sampled local educational agencies (LEAs), stratified by region, district enrollment, and wealth and invited participation by all state-supported special schools. Students receiving special education services were randomly selected from district or school rosters to yield nationally representative estimates that would generalize to all students receiving special education services in the NLTS2 age range (Wagner, Kutash, Duchnowski, & Epstein, 2005). Each student's eligibility for special education services was determined by the school district or special school (i.e., one serving only students with disabilities) from which the student roster was sampled.

Study Sample

The sample of youth with ASD in our study includes students who were in the special education disability category of autism³ at wave 1 (2001) and remained in the study at Wave 5

² Multiple waves of data collection refer to repeated collection of data among the same population sample. A wave is defined as one period of data collection for the sample.

³ The criteria for a special education determination of autism differs from state to state and may differ from the criteria specified in the Diagnostic and Statistical Manual of Mental Disorders in use at the time NLTS2 recruited its sample (Fourth Edition, DSM-IV). However, more than 95% of children with a school designation of autism also

(2009). The initial NLTS2 sample included more than 11,000 high school students ages 13 through 16 who were receiving special education services on December 1, 2000. There were approximately 920 students identified in the autism category during secondary school at the first data collection/wave 1; 660 of them remained in the study at wave 5.

Results were weighted using the cross-wave, cross-instrument weight appropriate for analyzing multiple waves of NLTS2 data so that findings are nationally representative of students with ASD in the NLTS2 age range and time frame (Valdes et al., 2013). The weights were computed by taking into account various youth and LEA characteristics used as stratifying variables in the sampling and nonresponse in those strata at each wave and across waves. Unweighted sample sizes in this paper were rounded to the nearest 10, as required by the U.S. Department of Education.

Table 1 shows the characteristics of the young adults with ASD weighted to represent the population. Consistent with epidemiological estimates, 85.4% of youth were male. The population represented in NLTS2 was diverse in terms of ethnicity, race, and family socioeconomic status. Overall, 54.9% had either a lot of trouble or no ability to converse. More than one-third (37.9%) of parents expected the youth to attend postsecondary school after high school. In addition, 84.5% of youth with ASD were included in general education classes. The rates of inclusion in general education English, math, science, and social studies classes were 54.0%, 48.9%, 53.2%, and 53.3%, respectively. Overall, 29.6% attended either a 2- or 4-year college at some time in the period addressed in NLTS2.

meet DSM-IV-based case criteria in public health surveillance studies specific (Bertrand et al., 2001; Yeargin-Allsopp et al., 2003).

<Table 1>**Intervention Variables**

The intervention variables were extracted from the secondary school transcript data, using only complete transcripts. A transcript was considered complete if it indicated that a student had graduated, completed his/her high school program, aged out, or dropped out, and also included complete transcript information for all the grading periods the student had been in high school (Newman, Wagner, Huang, et al., 2011; Newman, Wagner, Knokey, et al., 2011). General education inclusion was dichotomously coded 1 if a student ever had a course in a general education setting when s/he was in secondary school. Four additional dichotomous intervention variables—whether or not youth took English, math, science, and social studies in secondary school general education classes—also were extracted from the secondary school transcript data.

Outcomes

Youth with ASD who were ever enrolled in a college or university were identified by parent and youth reports of college enrollment in any of the waves of data collection at which a youth was out of high school. For each available wave of data, two survey items were asked: whether since leaving high school the youth had ever attended (1) a 2-year or community college and (2) a 4-year college or university. A dichotomous measure of any 2- or 4-year college was created based on these survey items (1 if either survey item was 1; 0 if both the survey items were 0). Please note that no mention was made of college or university programs specifically for persons with disabilities.

Covariates

Covariates, measured at waves 1 and 2, included demographic characteristics, parental expectations, disability severity, and academic achievement. Demographic variables reported by

parents or students' school districts included youth's gender, coded 1 for male; age in years at the first data collection; race/ethnicity, coded as two dichotomous variables for African American and Hispanic; family income, coded as two dichotomous variables for incomes <= US \$25,000 and US \$25,000 to \$50,000; and mother's education level, coded as 1 = less than high school, 2 = high school graduate or GED, 3 = some college, or 4 = BA/BS degree or higher; and a dichotomous variable coded 1 for parents ever having attended a PSE institution. Research has shown such factors to be significantly related to variations in college enrollment for youth with disabilities (Cameto, 2005; Shattuck et al., 2012). Additionally, parents' expectations for their children's futures have been linked to increased participation in PSE and employment (Chiang et al., 2012; Doren, Gau, & Lindstrom, 2012). For this study, parents' and youth's expectations regarding whether the youth would enroll in a PSE program in the future were coded on a scale of 1 to 3: definitely would, probably would, and probably or definitely would not.

Differences in the nature and severity of a youth's disability also can have a powerful influence on youth outcomes (e.g., Cameto, 2005; Carter et al., 2012; Newman, 2005b). Following Daley, Simeonsson, and Carlson (2009)'s suggestions, five variables were selected because of their effectiveness in characterizing disability severity: presence of attention deficit disorder/ attention deficit hyperactivity disorder (ADD/ADHD), social skills, conversational ability, functional cognitive ability, and self-care skills.

Parents responded to the following question to indicate whether or not youth had ADD/ADHD: "Has the youth been diagnosed with attention deficit disorder or attention deficit/hyperactivity disorder? These are sometimes called ADD or ADHD." Although parent-reported ADD/ADHD cannot be equated with the results of a professional evaluation, parent reports are often used in scientific studies (Braun, Kahn, Froehlich, Auinger, & Lanphear, 2006),

and some argue that they may be preferred over medical or school records (Pless & Pless, 1995). Research also has validated parents' reporting of children with ADHD, finding them to be adequately accurate and sensitive to detecting changes in symptoms over the course of treatment (Biederman et al., 2004). Youth's social skills were measured by summing the responses to 11 questions, each with three response categories (1=never, 2=sometimes, 3=very often), from the Social Skills Rating Systems (SSRS)-parent version (Gresham & Elliott, 1990) . The social skills score ranges from 11 to 33, with a reliability of alpha=0.79. Parents rated youth's conversational ability as 1=doesn't converse at all, 2=has a lot of trouble conversing, 3=has a little trouble conversing, or 4=converses as well as other children his/her age. Functional cognitive skills were measured using a scale from 4 (low) to 16 (high) based on parents' reports of how well their children were able to do the following four tasks without help: tell time on an analog clock, read and understand common signs, count change, and look up telephone numbers and use a telephone. Each item had four response categories: 1=not at all well, 2=not very well, 3=pretty well, 4=very well. A summation of the scores on the four items measures students' overall cognitive functioning with an internal consistency reliability of 0.93. Using the same response categories, self-care skills were measured by summing the scores (on a scale of 2 to 8) on how well youth dresses him/herself independently and feeds him/herself independently.

Youths' academic achievement was measured by grade point average (GPA) from the high school transcript; GPA scores ranged from 0.0 to 4.0. A second measure is a dichotomous variable indicating whether or not youth were able to take standardized achievement assessments at either wave 1 or 2. Youth who had cognitive or behavioral limitations had an alternative assessment completed for him/her by a knowledgeable adult instead of taking the standardized achievement assessments.

Propensity Score Methodology

Propensity score techniques are quasi-experimental approaches developed to approximate findings obtained from randomized control trials (Becker & Ichino, 2002). They have been increasingly used in observational studies with cohort designs to reduce selection bias in estimating treatment or intervention effects when randomized controlled trials are not feasible or ethical (Rosenbaum & Rubin, 1983, 1984, 1985). Propensity score methods enable quasi-experimental contrasts between students experiencing naturally occurring treatments and comparison groups whose members are similar on other factors included as covariates in the models. This study used propensity score methods to understand whether participation in any general education classes is associated with higher college enrollment rates, and whether participation in four core general education academic subjects is associated with higher college enrollment rates for youth with ASD. The propensity score is the predicted probability of participating in a treatment (e.g., participation in general education classes) based on a set of potentially confounding covariates (i.e., student demographic and disability characteristics, student academic achievement, and parents' expectations for PSE) using logistic regression. Propensity scoring attempts to equalize the mean values of potentially confounding observed covariates in the treatment and comparison groups, assuring that differences in outcomes between the treatment and covariate effect are not the result of differences in mean values of those covariates.

Two types of analyses to estimate the average treatment effect on the treated (ATT) were conducted. One analysis estimated the ATT in the sample (SATT). The other estimated the average ATT in the population (PATT) represented by NLTS2 students with ASD. Analyses of SATT were adjusted for confounding using inverse propensity score estimators, as recommended

by Curtis, Hammill, Eisenstein, Kramer, and Anstrom (2007); Hirano, Imbens, and Ridder (2003); and Rosenbaum and Rubin (1983). Specifically, the weight for treated students was their survey weight (or, in the case where the intent is not to project to a population, the weight is 1.0) and the weight for nonparticipating students was equal to their survey weight multiplied by $(p_i/1-p_i)$, where p_i is the propensity score for the i -th comparison student (Harder, Stuart, & Anthony, 2010; Hirano et al., 2003). For analyses of PATT, we adjusted for confounding using the approach recommended by DuGoff, Schuler, and Stuart (2014). In this analysis, the weight for treated students was their survey weight and the weight for nonparticipating students was equal to their survey weight times their propensity score transformed to an odds scale.

The SATT and PATT of general education inclusion were estimated using a weighted logistic regression model. The odds ratio (OR) from each model can be interpreted as the measure of association between general education inclusion and the outcome adjusted for the estimated propensity of inclusion. This essentially weights the comparison group to create balance with the treatment group on observed covariates and thus estimates the effect of participation for those individuals who actually participated. Weighting was selected over other approaches such as matching because of good performance in this dataset (details below), flexibility with the distribution of the data, an ability to manage time-dependent covariates and censored data, and because it retains all sample members in the analysis. After propensity score weighting for control students, we examined the standardized mean score (the difference in means for the treatment and comparison groups divided by a pooled standard deviation) to assure that they were less than 0.25, thereby assuring covariate balance (What Works Clearinghouse, 2008).

Handling Missing Data

Missingness rates for covariates ranged from 0% to 21%, with the exception of high school GPA, which was 52%. We followed two steps to handle the missing covariates, which were mostly measured at wave 1. First, missing demographic covariates at wave 1 were filled in with the same variables from wave 2, which constituted less than 3% of the total observations. Second, missing data on covariates were imputed 20 times using Stata's ICE (Imputation by Chained Equations) procedure (Royston, 2004, 2005, 2007, 2009; Royston, Carlin, & White, 2009; I. R. White, Royston, & Wood, 2011) to impute 20 implicants. Imputations were performed on all variables used in the analyses to avoid bias associated with listwise deletion and to capture the information contained in the correlation between covariates and the outcome and treatment variables.

However, as recommended by Little and Rubin (2002), I. R. White et al. (2011), and Von Hippel (2007), we did not use imputed values for the outcomes or treatments in the analyses (i.e., after imputation, we reset the outcome and treatment variables to missing in all implicate data sets). Analyses conducted on imputed data were aggregated using the Stata mim procedure (a command for analyzing multiply imputed datasets), which combines regression results across imputations and adjusts the standard error estimates to accurately reflect the uncertainty due to missingness.

Results

Baseline Equivalence After Propensity Score Weighting

To ensure that the propensity score method successfully created balanced treatment and comparison groups, we compared the standardized mean differences between the two groups for each covariate before and after propensity score weighting for both SATT and PATT. The balance on the covariates in the analysis was greatly improved after applying the propensity

score weighting method for both SATT and PATT. Due to space limitation, data presented in Table 2 show the balance for SATT only. Before propensity score weighting, the differences on covariates ranged from -0.32 to 1.25 standard deviations; whereas after propensity score weighting, the differences on covariates ranged from -0.31 to 0.18 standard deviations, which is lower than the What Works Clearinghouse 0.25 cutoff for baseline equivalence for quasi-experimental studies in most cases (What Works Clearinghouse, 2008). The treatment-control difference on each covariate was measured by Hedge's g effect size, which was calculated by dividing the differences by the pooled standard deviations of the two groups. Therefore, participants and nonparticipants were very similar on all potentially confounding covariates after propensity score weighting.

<Table 2 >

Without propensity score weighting, the unadjusted difference in college enrollment rates was significant when comparing students with ASD who were included in any general education classes as well as each specific core academic class to their peers who were not for both the sample and the population (comparing “Treatment” and “Control” columns, Table 3). Without propensity score weighting, the unadjusted difference in college enrollment rates is biased because the apparent difference in college enrollment rates may be affected by the characteristics that also affected whether or not a student was included in general education, rather than indicating the effect of general education inclusion.

Inclusion in Any General Education Class

After conducting propensity score weighting to remove selection bias, Table 2 shows that treatment and control groups were comparable on important background characteristics. The weighted logistic regression estimating the effect of general education inclusion shows that the

differences in propensity-adjusted college enrollment rates between those who took any general education classes and those who did not were no longer significant (comparing “Treatment” and “Weighted Control” columns, Table 3). Reporting results from the same sets of weighted logistic regression models, the last column in Table 3 displays the odds ratio (OR) estimating the ATT of general education inclusion for the sample and the population. In summary, the effect of whether a student with ASD ever took a class in general education setting was not significant for either the ATT sample or the population.

Inclusion in Four Core Academic Classes

However, students with ASD who took four core academic classes - English, math, science, or social studies – in general education classes had significantly higher odds of attending a 2- or 4-year college than their peers who did not take these classes for both the ATT students in the sample and those in the population, with the exception of the ATT population estimate on the effect of taking general education English classes. For example, participation in general education math, science, and social studies classes can effectively boost the odds of attending college by 521% (OR=6.21, 95% CI:1.88–20.56, $p < 0.01$), 469% (OR=5.69, 95% CI:1.89–17.65, $p < 0.01$), and 191% (OR=2.91, 95% CI:1.10–7.71, $p < 0.05$) for youth with ASD in the population, respectively (Table 3).

<Table 3>

Discussion

The purpose of the study was to understand the relationship between high school general education inclusion and 2-year or 4-year college attendance for youth with ASD. This study has broken new ground in identifying the inclusion of high school students with ASD in general

education core academic classes (math, science, and social studies) as a best practice for college preparation.

Some studies suggest that many states and school districts may not be in full compliance with IDEA's LRE provisions (J. White & Weiner, 2004), and other studies indicate that inclusion practices vary with disability severity (Wei, Christiano, Yu, Wagner, & Spiker, 2014). This study builds on previous findings by revealing that, although the majority of students with ASD had access to some aspects of the general education curriculum, only half of them were included in general education core academic classes in high school. Therefore, the rates of students with ASD included in general education core academic classes can be improved.

Furthermore, our study provides evidence of the linkage between high school general education inclusion and college enrollment among students with ASD. Although 84.5% of youth with ASD were included in one or more general education classes in high school, which may have conferred a variety of academic and social benefits (Newman, Wagner, Huang, et al., 2011; Newman, Wagner, Knokey, et al., 2011), our analyses show that including students with ASD in general education classes overall is unrelated to college enrollment rates. This is consistent with the findings of Foster and Pearson (2012) that the absolute amount of time spent in inclusive classrooms is not related to college attendance.

However, this study identifies a positive effect on college enrollment when students are included in general education math, science, and social studies courses and emphasizes the importance of inclusion in core academic classes. These findings are consistent with studies on the beneficial impacts of taking core academic classes on college readiness (ACT, 2014) and taking high school math and science classes on college enrollment for students in the general population (Cho, 2007; Hill, 2008; Tyson, Lee, Borman, & Hanson, 2007; Zettel & Ballard,

1982). The study also confirms findings from Wei, Yu, et al. (2015) that advanced math classes were associated with choosing a college major in STEM fields for youth with ASD.

Implications for Practice

Over the past few decades, the prevalence of ASD has steadily increased. The interest of parents, special educators, and researchers in improving young adult outcomes among individuals with ASD has been increasing rapidly in the last decade (Shattuck et al., 2012). Studies have found that these students can be successful in PSE when provided with appropriate accommodations and supports (Jefferson-Wilson, 1999; VanBergeijk, Klin, & Volkmar, 2008). However, about two-thirds of students with ASD do not apply for college admission (Glennon, 2001; Wei, Yu, Shattuck, McCracken, & Blackorby, 2012) despite 84.4% of them expressing an interest in doing so (Wagner et al., 2007). Our findings suggest that including students with ASD in any high school general education class is not adequate preparation for PSE. Rather, it is an increase in academic rigor and a stronger focus on college preparation that are key to improving college enrollment rates among students with ASD.

Our findings have important implications for special educators, whose role is to prepare youth with ASD to make a successful transition from high school to their young adult lives. For youth who express an interest in college, educators should be mindful about including a well-articulated and detailed goal of college enrollment in their transition plan (Wei, Wagner, Hudson, Yu, & Javitz, 2015). NLTS2 data show that only one-fifth of students with ASD had college enrollment as a transition goal (Cameto, Levine, & Wagner, 2004). To achieve this goal, students' plans should call for their participation in rigorous core academic courses and specify supports and services needed for them to succeed there. This should be used in conjunction with other college preparation strategies, such as providing support in completing applications,

providing self-determination instruction to support youth in advocating for PSE accommodations, and contacting 2- and 4-year colleges on the students' behalf.

Further, we agree with others who have called for future research to identify instructional strategies that are effective with students with ASD (e.g., Hendricks & Wehman, 2009) so they are prepared academically for college. To date, there is a dearth of research on effective instructional strategies for high school students with ASD, though some promising strategies that can be used in the general education classes include differentiated instruction, systematic instruction, comprehensible/structured learning environments, specialized curriculum content, visual supports, and assistive technology (Iovannone, Dunlap, Huber, & Kincaid, 2003; The Ontario Ministry of Education, 2007). Identifying specific instructional strategies at the high school and college level, and determining how these instructional strategies can enhance and be enhanced by other evidence-based interventions and programs offered to students with ASD – such as individualized supports and services, functional behavioral assessments (Hendricks & Wehman, 2009; Iovannone et al., 2003), or community-based experiences (Schall & McFarland-Whisman, 2009), could greatly improve the opportunities for students with ASD to transition into and succeed in postsecondary education settings.

Study Limitations

There are limitations to consider when interpreting these findings. First, despite including a variety of covariates in the analysis and balancing the intervention and comparison groups, unobserved confounding is a concern in propensity score modeling. This is a situation in which there is an unmeasured factor that might be correlated with both the likelihood of participation in the intervention and the likelihood of the outcome; for instance, a student's desire or intent to pursue college enrollment. Future research should include such important factors in the

propensity score models. Second, college enrollment was reported through the parent or young adult survey instead of college registration records, which may result in potential reporting biases. Future research should validate the results of this study through other data sources (e.g., enrollment data from the university disability support office). Third, we did not have norm-referenced measures of cognitive functioning and disability severity and could only rely on parent-reported conversation, ADD/ADHD status, and self-care, social, and cognitive skills as proxies for the degree of disability severity. Fourth, this study did not address the college completion rates of students who enrolled in 2- or 4-year colleges. Future studies could more comprehensively examine the college graduation rates of students with ASD. Finally, information on types, location, and cost of colleges and funding for college is not available in the NLTS2 dataset. Future studies could usefully control for these factor when examining the relationship between general education inclusion and college enrollment.

The Strength of this Study

Despite these limitations, this study has several strengths. The national sampling frame, large size, and diversity of this sample increase external validity. The use of propensity score methods is innovative and strengthens the causal interpretation for the association between general education inclusion and college enrollment. The extensive list of covariates included in both the propensity score modeling procedure and ATT estimation not only ensures that participants and non-participants were similar on as many aspects as possible, but also makes the ATT effect of inclusion more robust. Our measure of inclusion was directly extracted from secondary school transcript data, which is more reliable than parent- or student-reported inclusion status. Lastly, this study fills the gaps in the inclusion literature for youth with ASD, particularly those in secondary schools.

Table 1
Descriptive Analysis of Youth with ASD

Variables Used in this Study	Full Sample		
	Unweighted n	Weighted % or Mean	s.e.
<i>Covariates</i>			
Male (%)	960	85.38	2.00
African American (%)	960	21.97	0.94
Hispanic (%)	960	10.03	0.85
Age (%)			
13	960	7.43	1.53
14	960	27.74	3.00
15	960	23.05	2.49
16	960	25.49	2.84
17	960	16.29	2.13
Income (%)			
Low: ≤US \$ 25,000	900	25.32	1.03
Medium: US \$25,001 - US \$ 50,000	900	28.99	0.93
High: > US \$50,000	900	45.69	0.84
Mother's education level (%)			
Less than high school	900	8.30	1.27
High school graduate or GED	900	25.29	2.62
Some college	900	33.94	2.95
B.A. or higher degree	900	32.47	2.73
Parent ever attended postsecondary education (%)	890	71.41	2.28
Parent expectation of youth attending postsecondary education (%)			
Definitely will not	900	36.21	2.78
Probably will not	900	25.91	2.25
Probably will	900	23.21	2.40
Definitely will	900	14.67	1.59
Has ADD/ADHD (%)	760	18.54	2.55
Social skills scale score (sum of 11 questions; range: 11-33)	930	11.32	0.15
Cognitive functioning skills scale score (sum of 4 questions; range: 4-16)	910	10.94	0.24
Conversation ability (%)			
Does not carry a conversation at all	900	18.10	2.30
Has a lot of trouble carrying conversation	900	36.81	2.86
Has a little trouble carrying conversation	900	30.62	3.14
Converses just as well as other children	900	14.47	1.91
Had a direct assessment score (%)	960	43.93	3.16
Self-care skills scale score (sum of two questions; range: 2-8)	910	6.97	0.08
High school GPA (range:0-4)	460	3.03	0.07
<i>Intervention</i>			

Had any course in a general education setting (%)	500	84.53	2.09
Took general education English classes (%)	500	53.98	3.32
Took general education math classes (%)	500	48.91	3.75
Took general education science classes (%)	500	53.22	3.53
Took general education social studies classes (%)	500	53.25	3.57
<i>Outcomes</i>			
Attended any 2- or 4-year college (%)	710	29.63 ^a	2.63

Note: ASD = Autism Spectrum Disorder; GED= general education development; ADD/ADHD = attention deficit disorder/attention deficit hyperactivity disorder; GPA = grade point average.

Source: NLTS2, waves 1 through 5. Percentages were weighted to population levels. Unweighted N was rounded to the nearest 10.

^aThe percentages of students attending any 2-year college is 24.46% and any 4-year college is 13.55%.

Table 2

Treatment and Control Balance Statistics on Covariates Before and After Propensity Score Weighting for SATT

Covariates	Had course in general education			Took English in general education			Took math in general education			Took science in general education			Took social studies in general education		
	Treatment	Pre-PSW	Post-PSW	Treatment	Pre-PSW	Post-PSW	Treatment	Pre-PSW	Post-PSW	Treatment	Pre-PSW	Post-PSW	Treatment	Pre-PSW	Post-PSW
Male (%)	86.67	.06	-.22	85.51	-.06	-.18	86.26	-.01	-.09	86.34	-.003	-.10	87.36	.06	-.10
African American (%)	21.21	-.29	-.01	18.83	-.23	-.01	19.32	-.18	.01	18.88	-.24	.05	17.53	-.28	.08
Hispanic (%)	6.26	.03	.10	4.46	-.16	-.04	3.34	-.24	-.04	42.90	-.19	-.04	2.76	-.31	-.02
Average age	15.15	-.32	-.29	15.12	-.17	-.06	15.10	-.19	-.04	15.10	-.22	-.03	15.05	-.28	.03
Income low (%)	21.32	-.22	.02	17.26	-.29	-.07	17.06	-.28	-.03	17.93	-.27	-.08	19.14	-.17	-.17
Income medium (%)	28.00	.05	-.12	29.06	.08	-.001	27.67	-.01	-.06	29.24	.09	-.09	27.32	-.02	-.07
Mother's education level	3.01	.23	-.07	3.12	.37	.06	3.10	.28	.13	3.08	.27	.16	3.13	.37	-.001
Parent ever attended postsecondary education (%)	76.99	.14	.03	80.32	.19	.07	80.66	.22	.13	79.78	.19	.18	82.79	.35	.06
Parent expectation of youth attending postsecondary education (%)	1.63	.90	-.03	1.94	1.13	.02	1.96	1.02	.06	1.90	1.03	.06	1.92	.95	.06
Has ADD/ADHD (%)	18.66	.19	-.31	18.52	.07	-.05	17.77	.01	-.08	18.04	.04	-.10	18.42	.05	-.12
Social skills scale score	12.03	.44	-.06	12.30	.32	-.10	12.19	.22	-.002	12.14	.23	.09	12.11	.18	-.01
Cognitive functioning skills scale score	12.41	1.25	.10	13.29	1.07	.11	13.46	1.05	.14	13.17	1.01	.15	13.46	1.12	.06
Conversation ability	1.77	1.11	-.07	1.91	.74	.02	1.95	.77	.08	1.90	.74	.08	1.93	.75	-.01
Had a direct assessment score (%)	64.24	.77	-.18	70.84	.57	.003	70.76	.50	.12	68.74	.48	.07	72.01	.59	.02
Self-care skills scale score	7.39	.80	-.06	7.47	.44	.10	7.54	.52	.04	7.48	.49	.05	7.53	.55	.09
High school GPA	3.00	-.07	-.21	2.94	-.27	-.01	2.92	-.31	.01	2.93	-.30	.06	2.93	-.29	.16

Note: SATT= average treatment effect on the treated in the sample; PSW= propensity score weighting; ADD/ADHD = attention deficit disorder/attention deficit hyperactivity disorder; GPA = grade point average.

Source: NLTS2, waves 1 through 5.

Table 3

ATT Effect of General Education Inclusion on Postsecondary Education Enrollment Rates for Youth with ASD

Intervention	ATT estimates	Any 2- or 4 year college enrollment rates			
		Treatment	Control ^a	Propensity Weighted Control ^b	Propensity Adjusted OR [95% CI] ^c
Took:					
Any course in a general education setting	SATT	43.62	17.10***	34.64	1.46 [0.49, 4.34]
	PATT	45.72	10.53***	30.17	1.95 [0.45, 8.44]
General education English classes	SATT	58.06	19.82***	27.23*	3.71* [1.53, 8.98]
	PATT	55.99	16.93***	27.58	3.34 [0.98, 11.37]
General education math classes	SATT	61.74	21.36***	28.24**	4.10** [1.70, 9.90]
	PATT	64.27	15.50***	22.46**	6.21** [1.88, 20.56]
General education science classes	SATT	60.77	20.22***	29.46**	3.71** [1.60, 8.57]
	PATT	61.70	14.50***	22.07**	5.69** [1.89, 17.65]
General education social studies classes	SATT	61.00	21.38***	33.25**	3.14** [1.37, 7.18]
	PATT	59.08	18.59***	33.16*	2.91* [1.10, 7.71]

* $p < .05$, ** $p < .01$, *** $p < .001$

Note: ASD=Autism Spectrum Disorder; ATT= average treatment effect on the treated; SATT= average treatment effect on the treated in the sample; PATT = average treatment effect on the treated in the population; OR = odds ratio; CI=confidence interval.

^aControl column indicates the college enrollment rates among control students—those with ASD who were not included in general education settings. The treatment-control differences in college enrollment rates were tested by weighted chi-square tests.

^bPropensity weighted control is the estimated propensity of the control group enrolling in college based on the weighted logistics regression model controlling for demographic, disability, academic, and parent expectation. It is calculated as $100 * Pt / [OR (1-Pt) + Pt]$ where Pt is the treatment group college enrollment rates and OR is the propensity adjusted OR. The significance level indicates whether treatment and control groups are significantly different in the weighted logistic regression model.

^cPropensity adjusted ORs controlled for demographic, disability, academic achievement, and parent expectation covariates in the weighted logistic regression model.

Source: NLTS2, waves 1 through 5.

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